



Mirages in the Desert

Opportunity Knocking

by Major John Dornstadter,
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Editor's Note: This article responds to "False Targets: Mirages in the Desert" by Captain Michael D. Farris and First Lieutenant Peter A. Catanese, also in this edition. Captain Farris and Lieutenant Catanese identify targeting problems with the Q-36 Firefinder radar during Operation Desert Storm. This article explains the problems and outlines solutions to it.

Captain Michael Farris and Lieutenant Peter Catanese's article about Q-36 Firefinder false targets captures some of the perceptions that exist about our highly sophisticated, highly technical firefinder radars. What they saw and reported highlights a number of problems we need to correct.

This article reviews Captain Farris and Lieutenant Catanese's observations in the context of other such observations, explains why and how the problems exist and suggests solutions to the problems. The fire support community has a professional mandate to examine these observations and to improve our part on the combined arms team as we embark into the era of joint AirLand Operations.

Mirage Analysis

"False targets" exist, have existed since the first radar was fielded and probably will continue to exist well into the

future. "Mirages in the Desert" correctly states false targets were reported in Panama on Operation Just Cause and in Lebanon. Additionally, they've shown up in exercises where radars were observing live fire or where aircraft were operating in a close support role. Sometimes they occur for no apparent reason.

While this phenomena has been the subject of substantial debate in the radar and target acquisition community, it has rarely gained attention outside that community. The current controversy is similar to those that emerged after Lebanon and Just Cause that slipped to the side as more pressing "peacetime" priorities drew attention away from this serious situation.

To discuss false targets, we must first accurately define the problem. Part of the problem is the targets aren't technically false. Such terminology suggests an attitude about the phenomena and the radars that isn't altogether correct.

Essentially, the problem exists when you accept the radar reports as 100 percent perfect. Few things, if any, are accepted 100 percent of the time as perfect. Firefinder reports should be no different. Firefinder is a radar emitter and collector mated to a computer. It produces errors in precision, accuracy and reliability (three entirely different measures) to a degree as do all machines. It's a tool.

Firefinder as a Tool

A review of how Firefinder works underscores the terminology problem inherent in false targets. Firefinder doesn't report targets to the operator or to the tactical fire direction system (TACFIRE). It reports the extrapolated location of an object's origin and impact. In the hostile fire (vice friendly fire) mode, Firefinder lays a blanket of thin radar beams on the topography of what it sees as the horizon; these are the "fence beams." When an object penetrates this fence (more aptly blanket), Firefinder tags it with several verification beams to see if it's behaving as Firefinder's computer algorithms describe a ballistic projectile would behave.

This is an important point in the discussion of false targets. The radar "sees" anything that penetrates its fence (birds, insect swarms, rifle bullets, artillery rounds, airplanes, etc.) if the object has enough surface area, given the acquisition distance, to reflect radar energy back to the radar.

When the computer has enough "tags" to meet its test that the object is traveling on a ballistic trajectory within certain velocity parameters, it then causes the radar to send a series of tracking beams at the object. The results of this tracking give the computer enough information about the segment of the projectile's ballistic arc that the computer can mathematically extrapolate or project from that segment where the arc began and where it will end. The radar basically "number crunches" a prediction, not an absolute. And this prediction is of launch and impact points. We get into trouble when we refer to the prediction as a target. It's a "predicted" target indicator or suspect target.

Analysis of this report with other reports (by the radar or other sources) allows us to describe the location as a confirmed target. If what the radar saw and tracked behaved ballistically over the

entire arc of the trajectory, we have an accurate predicted origin and impact point. If the object was an artillery round (without rocket-assisted projectile or other ballistically modifying capability), we have a relatively good, precise and accurate target location to engage.

But if the object behaved non-ballistically later or earlier in its trajectory than the observed segment of the arc, we still get a precise predicted grid of origin and impact. But, at best, it's inaccurate and generally worthless for counterfire purposes (maybe not for intelligence).

The radar has behaved exactly the same in each instance, but we have to understand and properly use the information it gives us. In the second instance, there was no "false" target. That report indicated a target may exist, unconfirmed by other information. And as is usually the case, we blindly accept it as a target. ("Blindly," I say, because that's what we've been taught.)

In addition, about eight times in a 24-hour period, the radar (whether radiating or not) will generate a diagnostic target internally. This is eventually reported to the operator just as an external acquisition would be. The target indicator isn't based on any external action, yet the operator can't distinguish it from an externally generated target. If accepted without confirmation, we've erred.

So we have three classes of observations reported to the operator. First, there is an externally observed object that behaves ballistically from origin to impact. Firefinder accurately and precisely reports its predicted origin and impact point. Only with confirmation (volley fire, a second adjusting round from the same location, a decision that this is a tactically sound location for an indirect fire system, etc.) can we call the report a target and properly engage it.

Second, there is the externally observed object that behaved ballistically while the radar was tracking it. But before or after the radar tracked it (under the fence), it behaved nonballistically. The radar report gives us a precise but inaccurate origin and (or) point of impact. If we don't confirm it as a target, we've erred.

Third, some targets generated are part of the radar's diagnostic test. Again, we must confirm it as a target.

Mirage Control

There's nothing we can do to alter the physics and mechanics of Doppler radar beams or how and when they reflect. But we can do some things to keep from falling into the false target trap. Here are nine solutions.

(1) We can seek a software solution to the diagnostically generated targets. If the test needs to be reported to the operator at all, he should see it with some sort of software "flag" so he knows it isn't a valid acquisition.

(2) We shouldn't become complacent and treat this good machine and its outputs as anything other than a machine. Its reports aren't perfect.

(3) We should recognize Firefinder target reports are really target indicators or suspect targets so we must confirm them. We must never take the man "out of the loop"—always have a fire supporter clearing fires. It could be tragic to link a Firefinder (or any other sensor) directly to a shooter without analysis and clearing fires.

(4) We need to "get the word out." We shouldn't oversell this wonderful machine as perfect. We should describe its operation, capabilities and limitations accurately to those who rely on its reports. But first, we, as artillerymen, must fully understand this tool of our trade.

(5) In the schoolhouse, we need to emphasize the pros and cons of Firefinder and improve student understanding of the target processing chains.

(6) The leadership in the field must demand that those who serve in target processing or counterfire positions be properly trained. For many that means TACFIRE courses and the 13D: Field Artillery Target Acquisition Staff Officer's Course (FATASOC). This hasn't been a priority in the past, and the misperception of false targets as radar faults vice a characteristic of the machine points to a lack of education in those positions.

(7) The schoolhouse must demand that this issue be resolved.

(8) We must have quantifiable measures of success for our radar and counterfire teams. We must have clearly delineated standards in our doctrinal publications and our Army training and evaluation programs (ARTEPs) to guide

us and to measure the knowledge and execution capabilities of our teams. We don't have them now.

(9) We must train as we'll fight. Had our Firefinder radars been exercised in the hostile fire mode with the frequency that our gun crews exercise in the hostile fire mode, the central observations of "Mirages in the Desert" would have been common knowledge to all well before Desert Storm.

Conclusion

We have a lot of work to do to make the most of our Firefinders. Our radars perform today as they have for years. We are more aware of the radar's operational characteristics today, including what more we must learn. That presents us opportunities—not obstacles.

Our hope is our senior leadership won't repeat the post-Lebanon and post-Panama experiences of letting other peacetime priorities again push this issue into the shadows.

Well done, Captain Farris and Lieutenant Catanese.



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